International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 4, pp 264-267, April-2023

https://doi.org/10.47001/IRJIET/2023.704040

Review: Analisation of Mechanical Characterization of Aluminum Alloy 7075 Grade Reinforced with Aluminum Oxide

[1]V.Bharatharajan, [2]M.Aravindhan, [3]S.Dhayanidhi, [4]M.Hari Prasath, [5]M.Hari Haran

[1]Assistant Professor, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India
[2,3,4,5]Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India

***Abstract* - The mechanical properties of Aluminum Hybrid Matrix Composites (AHMCs) reinforced with Aluminum oxide (AL_2O_3) particles are investigated in this composition. The matrix material is an aluminum 7075 alloy with Al_2O_3 particles ranging from 3 to 9 wt percent in increments of 3 wt percent and a set quantity of 3 wt percent alumina. The stir casting technique was used to create the hybrid composites. On the prepared composites, the hardness and tensile characteristics were investigated. The amount of reinforcements increases the tensile strength and hardness of the hybrid composites, according to the findings. Properties and corrosion resistance have been achieved Under optimum conditions, a maximum Young's modulus of over 80 GPa, a maximum hardness of 1.39 GPa, and maximum wear resistance have been achieved. Due to the resistance of Al_2O_3 particles to corrosion in terms of electrochemical behavior, optimal composites have the lowest thermodynamic corrosion propensity and show higher pitting corrosion resistance. In addition, if the amount of Al_2O_3 is large, the formation of a continuous protective layer on the surface will be delayed and the corrosion resistance will decrease. The mechanical and wear properties of Al7075 - Al_2O_3 (3% and 6%) and Al7075 - Al_2O_3 (6% - 3%) composites are prepared and compared. The composites were made using the stir casting method, with the amount of reinforcement varying from 6 to 12 percent in 3wt% stages. Tests were performed on the Al7075 - Al_2O_3 composites, and hardness, density, and mechanical and parameters were evaluated according to industry standards.**

Keywords: Metal Matrix Composite, Aluminum, Al_2O_3, Alumina.

I. INTRODUCTION

Metal matrix composite is gaining a large momentum in attaining light weight and huge utilization in various engineering applications. Monolithic metals and their alloys cannot always meet the demands of today's modern engineering requirements. With addition of more than one material it is possible to achieve tailor made properties and meet the performance requirements for specific application. Materials are mainly added to change their properties in order to fulfill the requirements of design. Few researchers have incorporated fly ash in AA7075 to provide a better wear resistant, strength and hardness composite. Micro structural characteristics of AA7075 and its composite were compared and analyzed using Optical Microscope (OM) and SEM. It has been noticed that the fly ash particles have been dispersed uniformly in the composite. The composite has been prepared by liquid metallurgy technique. The hardness has been increased due to good union between fly ash and Al7075 alloy and homogenous homogenous dispersion of fly ash. Review on various combinations with Al7075 being the matrix and various components like SiC, TiO_2, TiB_2, B_4C, fly ash etc. being the reinforcements have contributed in improved mechanical characteristics. This paper emphasises on the composite prepared by liquid state processing techniques like stir casting methods. This process appears to be relatively simple and cost effective and can be made semi continuous or continuous by stirring. The coefficient of thermal expansion of hybrid composites decreased with increase in the content of Al_2O_3. On the other hand, thermal conductivity of composites decreases with hybrid reinforcements when evaluated with Al7075 alloy.

Aluminium based hybrid metal matrix composites with low cost reinforcements like Al_2O_3 by stir casting. Al_2O_3 were chosen as hybrid reinforcements owing to their superior mechanical, Tribological and physical properties. From the extensive review of literature, it is clear that its own oxide can be considered as efficient reinforcements with multiple benefits for synthesis of hybrid metal matrix composites. Further, very limited information exists with reference to mechanical properties with the combination of oxide reinforced Al7075 based metal matrix composites. In the light of the above, this work focuses on synthesis of Al7075- Al_2O_3 hybrid metal matrix composites by liquid metallurgy technique and characterization of its mechanical properties.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 4, pp 264-267, April-2023

https://doi.org/10.47001/IRJIET/2023.704040

1.1 Objective of the project

Because of their improved mechanical qualities, demand for aluminum hybrid metal matrix composites has risen in recent years to meet the needs of advanced technical applications. The choice of an appropriate combination of reinforcement materials has a significant impact on the performance of these materials. Carbides, nitrides, and oxides are among the reinforcing materials. The proposed components details are given below,

1) The mechanical properties of the produced composite were investigated due to the incorporation of different reinforcement components.
2) The suggested composite's density and mechanical parameters, such as ultimate tensile strength, yield strength, impact strength, hardness, and wear characteristics, are compared to unreinforced Al7075.

To prepare an Al7075 hybrid metal matrix composite (HAMMC) reinforced with particulates with different weight fr7075 actions of Aluminum oxide and

1.2 Scope of Project

Metal matrix composites are gaining a lot of traction as a way to achieve minimal weight and a lot of use in numerous technical applications. Monolithic metals and their alloys are not always able to meet the demands of modern engineering. It is possible to produce tailor-made qualities and match the performance criteria for a specific application by combining multiple materials. Materials are mostly added to alter their qualities in order to meet design requirements.

II. LITERATURE SURVEY

Dattatraya N et.al, presents a study on stir casing process and process parameter having Al alloy as a matrix phase and alumina (Al2O3) as a reinforcement. In their study, they have concluded the following points: (i) Stir casing process can successfully be used for manufacturing of AMMC's having low density and enhanced mechanical properties. 2) Stir casting process is cost effective and conventional route for manufacturing of composite material. 3) Material having isotropic nature can be manufactured successfully. 4) Preheating of mould reduces porosity and enhances mechanical properties. 5) Addition of Magnesium is important to increase wettability. 6) Design of stirrer decides the flow pattern of melt. 7) Stirrer speed, stirring time decides quality of casting.

Hariharan.R et.al, carried out the research work by fabricating Al6061 – TiB2 MMC by stir casting method. The addition of the TiB particles into Al-6061 is a good route to improve the mechanical properties of materials. The resulting composite showed the increase in tensile strength when compared to the unreinforced alloy. SEM and XRD analysis of the composite confirms the presence of TiB particle and its volume fraction. The increased volume fraction of the TiB particles contributed to increase the strength of composites. The dry sliding at room temperature shows that there is a definite increase in the wear resistance of Al6061 alloy by the addition of TiB_2 particles.

Pradeep R et.al observed the study of mechanical properties of Al- Red Mud and Silicon Carbide Metal Matrix Composite (MMC) of Aluminium alloy of grade 7075 with addition of varying weight percentage composition such as SiC8%+Al7075, SiC6%+Red mud2%+ Al7075, SiC4%+Red mud 4%+Al7075, SiC2%+Red mud 6%+Al7075, Red mud 8%+Al7075ed mud and Silicon Carbide particles by stir casting technique. The experimental result reveals that the combination of a matrix material with reinforcement such as SiC and Red mud particles, improves mechanical properties like tensile strength, compressive strength, hardness and yield strength.

Ravichandran M et.al carried out the research work by fabricating aluminium metal matrix composites through liquid powder metallurgy route. The aluminium matrix composite containing TiO_2 reinforcement particle was produced to study the mechanical properties such as tensile strength and hardness. The characterization studies are also carried out to evident the phase presence in the composite and the results are discussed for the reinforcement addition with the mechanical properties. Results show that, the addition of 5 weight percentage of TiO_2 to the pure aluminium improves the mechanical properties.

H. Izadi et.al investigated through FSP and has observed improvement in the micro hardness of Al–SiC composites produced by traditional powder metallurgy and sintering methods. The material flow in the stir zone during FSP was successful in uniformly distributing the SiC particles. However, when samples with 16% SiC (by volume) were processed, there were residual pores and lack of consolidation. An increase in hardness of all samples was observed after friction stir processing which was attributed to the improvement in particle distribution and elimination of porosity.

Keshavamurthy R et.al studied about Al7075-TiB_2 insitu composite, processed by stir casting technique using commercially available Al-10%Ti and Al- 3%Br master alloys. Both matrix alloy and composite were subjected to microstructure analysis, micro hardness test, grain size studies and tensile test. Microstructure shows fairly uniform

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 4, pp 264-267, April-2023

https://doi.org/10.47001/IRJIET/2023.704040

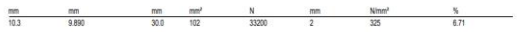
distribution of TiB2 particles in matrix alloy. Average grain size of the composite was lower than unreinforced alloy. Micro hardness, yield strength and ultimate tensile strength of Al7075-TiB_2 composite, were considerably higher when compared with unreinforced alloy. Uvaraja et.al observed that Hybridization is commonly used for improving the properties and for lowering the cost of conventional composites. Hybrid MMCs are made by dispersing two or more reinforcing materials into a metal matrix. They have received considerable research and trials by Toyota Motor Inc., in the early 1980s. Hybrid metal matrix composites are a relatively new class of materials characterized by lighter weight, greater strength.

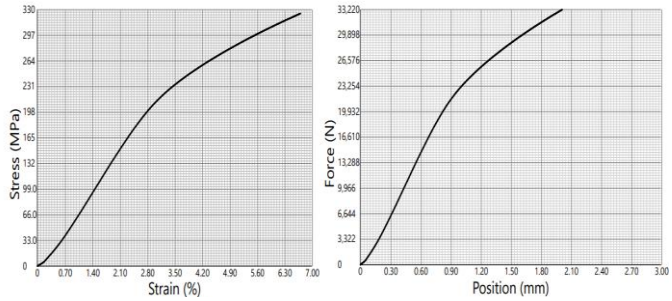
III. RESULTS AND DISCUSSIONS

3.1 Result for Hardness Test

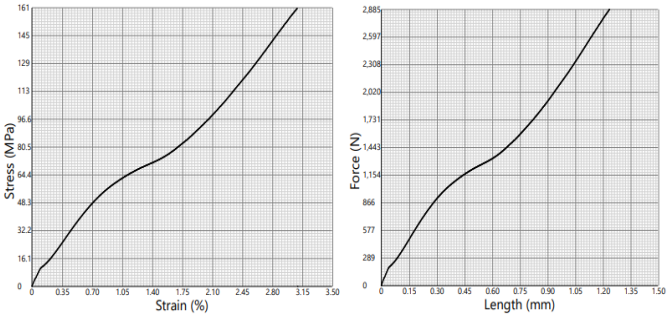
S.NO	B SCALE	TOP	MIDDLE	BOTTOM
Steel ball indentation (1/16), load =100 Kgf				
SAMPLE-1	HRB	40	43	47
SAMPLE-2	HRB	42	45	46
SAMPLE-3	HRB	39	41	41

3.2 Graph for Compression Test



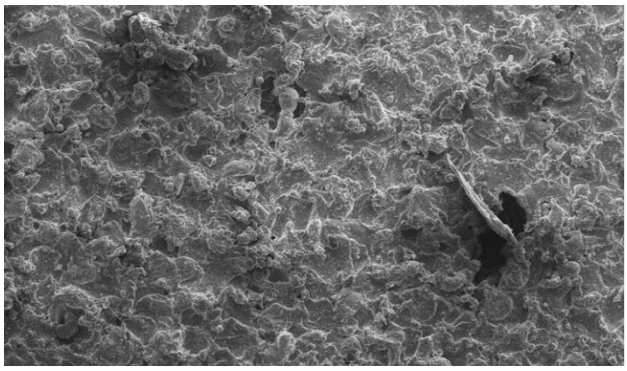


3.3 Graph for Tensile

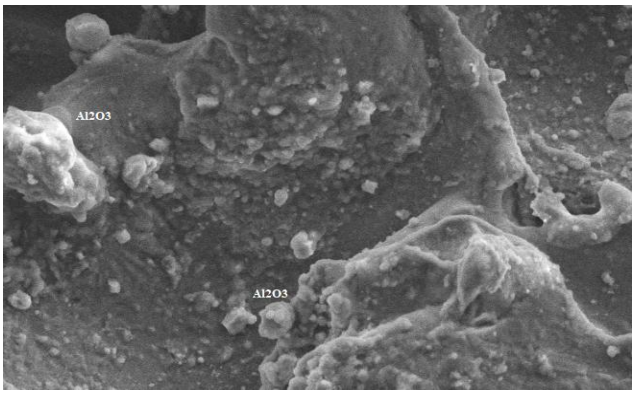


3.4 Sem Test

AL7075 with Al_2O_3 Layer 1



Layer 1



IV. CONCLUSION

In the present work, AA7075 with Al2O3, AMMCs were prepared by the stir casting process and the effect of its Oxide alumina particulate content on mechanical and tri biological properties of the prepared AMMCs were investigated both as cast and heat treated conditions.

The results can be summarized as follows:

- The composites at cast condition exhibits less hardness, tensile strength than heat treated (T6) condition, due to failure to form good hardening.
- The mechanical (hardness, tensile strength and percentage of elongation) properties for the alumina reinforced composite specimens are better than AL7075 matrix material in both conditions.
- The high content of Al2O3 particles in AMMCs lead to high wear resistance.

ISSN (online): 2581-3048
Volume 7, Issue 4, pp 264-267, April-2023
https://doi.org/10.47001/IRJIET/2023.704040

REFERENCES

[1] Keshavamurthy R, Pavan M, Abdul Tazamul Haq M, Zinge D, Mohammed Y (2015) Hardness and tensile behavior of forged Al7075-SiC composite. Int J Appl Eng Res 10 (55):3769–3772.
[2] Ramesh CS, Keshavamurthy R, Koppad PG, Kashyap KT (2013) Role of particle stimulated nucleation in re-crystallization of hot extruded Al 6061/SiCp composites. Trans Nonferrous Met Soc China 23(1):53–58.
[3] Mohanavel V, Suresh Kumar S, Srinivasan RV, Ganesha P, Anand KT (2017) Mechanical and metallurgical characterization of AA7075-fly ash composites produced by liquid state method. J Chem Pharm Sci (JCHPS) Special Issue (2):217–220.
[4] Nimbalkar SR, Vijay M, Satpute M (2015) Aluminium alloy Al7075 reinforcement and Stir casting–a review. IPASJ Inter J Mech Eng (IIJME) 3(11):038–046. ISSN 2321–6441.
[5] Karthigeyan R, Ranganath G, Sankaranarayanan S (2012) Mechanical properties and microstructure studies of aluminium (7075) alloy matrix composite reinforced with short basalt fibre. Eur J Sci Res 68(4):606–615.
[6] Chandel V, Bhatia OS, Sethi MS (2015) Fabrication and characterization of Al 7075-cenosphere composite & its comparison with pure Al 7075: a review. Int J Res Stud Sci, Eng Technol. ISSN: 2349–4751 (Print) & ISSN: 2349–476X (Online).
[7] Murthy KVS, Girish DP, Keshavamurthy R, Varol T, Koppad PG (2017) Mechanical and thermal properties of AA7075/TiO2/fly ash hybrid composites obtained by hot forging. Prog Nat Sci: Mater Int 27(4):474–481.
[8] Ramesh CS, Keshavamurthy R, Channabasappa BH, Ahmed A (2009) Microstructure and mechanical properties of Ni–P coated Si 3 N 4 reinforced Al6061 composites. Mater Sci Eng, A 502(1):99–106.
[9] Shivananda Murthy KV, Keshavamurthy R, Girish DP (2017) Mechanical characteristics of hot forged Al6061-Al2O3 composite. Appl Mech Mater 787:598–601.

AUTHOR BIOGRAPHY

V.Bharatharajan,
Assistant Professor, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India.

M.Aravindhan,
Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India.

S.Dhayanidhi,
Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India.

M.Hari Prasath,
Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India.

M.Hari Haran,
Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Tamilnadu, India.

Citation of this Article:

V.Bharatharajan, M.Aravindhan, S.Dhayanidhi, M.Hari Prasath, M.Hari Haran, "Review: Analisation of Mechanical Characterization of Aluminum Alloy 7075 Grade Reinforced with Aluminum Oxide" Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 4, pp 264-267, April 2023. Article DOI https://doi.org/10.47001/IRJIET/2023.704040

****

